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4. Insects of the Plant House.

HAVING glanced at some of the more common insects to be observed in our walks around the garden, we shall in this chapter confine ourselves to a more restricted field of observation, and be content simply with some glances around the plant house, a look at what may be found on the flowers in the parlor, or a survey of the insects of the petunias and geraniums in the cottage window. Every rose has its thorn, and, it may be added, its Aphides; the lily and azalea their Thrips, and the orange and oleander their scale insects. Few are the insects which afflict our household plants, but a great deal can be said of those few.

He who would know something of the marvels of biology, the origin of life and of specific forms, he who cares to trace anew the steps which Bonnet, Chamisso, Steenstrup and Owen trod in building up that wonderful theory of parthenogenesis, and learn how one insect may through a simple budding process cast off a thronging host of young, produced like the leaves which bud out from the tree, can in his room watch the Aphides of his roses or geraniums. He who would follow Herold, Kölliker, Zaddach, Claparède, Weismann and Kowalevsky in tracing the development of the insect from a primordial sphere of protoplasm to the adult, can employ the leisure of his winter evenings in such studies, observing each change through his microscope, and adding his mite to one of the grandest of biological studies, the growth and development of animals. Again, he who envies the delicate touch and deft fingers in unravelling the intricacies of insect anatomy, and emulates the master pieces of Straus-Durckheim or Newport, can try his patience and steadiness of hand in dissecting the insects of the conserva-

tory. Finally, he who would content himself with a thorough study of the insect crust, and trace the laws of growth of the insect frame, the principle by which the body walls are built up, one part at the expense of another, and would for himself rediscover Savigny's law of the identity of the jaws and antennæ with the legs, and acquaint himself with Audouin's grand generalizations regarding the composition of the thorax, and thus study the morphology of insects—in short, he who would study Nature, pondering as he walks, interrogating her at each step, training himself in the philosophy of science, striving after a combination of the insight of the poet with the inductive spirit of the natural philosopher, and thus avail himself of one of the shortest paths (if a short one he must take) to self culture, would do well to devote the leisure of his winter to the despised and neglected bugs on the plants in the window. If, reader, you are incredulous and think this mere rhapsody, try it. In the summer we are, mayhap, too much diverted by the attractions which draw us from one side to another and distract our thoughts. In the winter one is forced to be more of a specialist, and no one but a specialist need hope to obtain a far-reaching knowledge of natural phenomena. The great need of this country is educated specialists. We boast that everybody knows a little of everything. Let every one endeavor to learn a good deal of something.

So, good reader, provide yourself with a microscope, a Zentmeyer's student's stand we like best, with an inch and a half, a one-half and a one-fifth inch objective, such as Mr. Tolles makes, a Tolles triplet and stand for holding it, forceps, delicate scissors and needles mounted in handles, good strong eyes, a large stock of patience and fingers that are not all thumbs. Armed with these let us plunge into the wilderness of biology and follow the pioneers who have mapped out the path for us. Let us place an Aphis in the field of the microscope under the lowest powers. Remove

her tenderly from the rose or geranium. Confine her body within the animalcule box, and begin with the aid of the camera lucida to draw the creature. We learn to observe much more rapidly and accurately by drawing the object, while our thoughts are more aroused by the deliberate use of the pencil.

Observe the long slender feelers, or antennæ, those delicate tactile organs which act at once as feelers, as ears, and sometimes, as in the case of the carrion beetles, as noses, since it is by means of the sense organs lodged in the broad club-shaped feelers of these insects that they are enabled to scent their way to the carrion in which they lay their eggs. That they are delicate organs of touch any one can convince himself who observes the aphis or other insects while walking. Scarcely a step is taken until the air and ground or twig on which it treads has been thoroughly explored by these divining rods, which never fail in imparting knowledge on which their owner may be said to stake its life. No one, however slight his knowledge of the habits of insects, will deny that the antennæ are rightly called feelers. That the delicate sense of touch with which the antennæ are endowed sometimes serves insects, in the absence of all the other senses, is shown in the case of the cave insects, in some of which the eyes are entirely wanting. It is not unfrequently the case that the antennæ of cave insects are much longer and more delicate than those of their fellows which live an out-of-door life. Here the loss of sight has been made up to the insect by the increased sensibility of the feelers. Writers on the habits of cave insects (I refer particularly to the papers of the Danish naturalist, Schiödte) describe the extreme caution with which they explore the ground over which they are about to walk, feeling and groping in the dark for their prey, or watching the movements of their adversaries in this game of blind man's buff among the columns and stalactites of their grotto.

That the antennæ besides being feelers are also ears has been proved by Prof. A. M. Mayer. At a late meeting of the National Academy of Sciences, held in New York, he made a series of exceedingly ingenious experiments, which confirm the theorem of Fourier as applied by him in his propositions relating to the nature of a simple sound, and to the analysis by the ear of a composite sound into its elementary pendulum-vibrations; and which elucidate the hypothesis of audition of Helmholtz. Placing a male mosquito under the microscope, and sounding various notes of tuning forks in the range of a sound given by the female mosquito, the various fibres of the antennæ of the male mosquito vibrated sympathetically to these sounds. The longest fibres vibrated sympathetically to the grave notes, and the short fibres vibrated sympathetically to the higher notes. The fact that the nocturnal insects have highly organized antennæ, while the diurnal ones have not; and also the fact that the anatomy of these parts of insects shows a highly developed nervous organization, lead to the highly probable inference that Prof. Mayer has here given facts which form the first sure basis of reasoning in reference to the nature of the auditory apparatus of insects.

"These experiments were also extended in a direction which added new facts to the physiology of the senses. If a sonorous impulse strike a fibre so that the direction of the impulse is in the direction of the fibre, then the fibre remains stationary. But if the direction of the sound is at right angles to the fibre, the fibre vibrates with its maximum intensity. Thus, when a sound strikes the fibrils of an insect, those on one antenna are vibrated more powerfully than the fibrils on the other, and the insect naturally turns in the direction of that antenna which is most strongly shaken. The fibrils on the other antenna are now shaken with more and more intensity, until, having turned his body so that both antennæ vibrate with equal intensity, he has placed the axis

of his body in the direction of the sound. Experiments under the microscope show that the mosquito can thus detect to within five degrees the position of the sonorous centre. To render assurance doubly sure, Prof. Mayer, having found two fibrils of the antennæ of a mosquito which vibrated powerfully to two different notes, measured these fibrils very accurately under the microscope. He then constructed some fibrils out of pine wood, which, though two or three feet long and of the thickness of small picture-cord, had exactly the same proportion of length to thickness as the fibrils of the antennæ of the mosquito. He found that these slender pine rods or fibrils had the same ratio of vibration to each other as the fibrils of the mosquito."

Here a question arises. The song of the mosquito is undoubtedly a sexual call. Does the male detect the presence

FIG. 71.

Ocean Gnat.

of its female charmer by the different tones of her voice? Certainly the ears of the male with its feathered antennæ are far more acute than those of the opposite sex, the antennæ in her case mostly wanting those long vibratile hairs that give to him his acuteness of hearing. In this case

certainly the longest ears give the greater wisdom, however it may be among certain higher animals with a less number of feet than our mosquito boasts. The bushy antennæ of the feathered gnats (Chironomus) are perhaps still more acute organs of hearing than those of the mosquito, and here the great difference between the antennæ in the sexes may be seen by a glance at the accompanying figure (71) of the common ocean gnat of our harbors, the lower figure representing the antennæ of the female with their few short scattered hairs, while those of the male are very bushy.

The feelers of many moths are delicately feathered, those of the males being invariably with longer branches than in the other sex. They are particularly well developed in the males of the silk-worm moths, as for example in the large handsome Luna moth (see Pl. 2, representing, however, the female). The females of this group particularly are quite stationary, while the more active, restless males may be seen sailing majestically through the air in the twilight. If a female of this family be confined in a room or in a box out of doors, numbers of suitors for her hand and heart will come from far and wide. Collectors of insects take advantage of this trait, which they call "assembling." It is stated in an English work that an entomologist while walking out with a female Emperor moth in a box in his pocket was attended by twenty or thirty males fluttering anxiously about his person. They have also been known to seek their partners, held captive in the city of Manchester, from a distance of ten miles out of town. Now what is the faculty by which these sparks, with their antennæ gayly feathered and plumed, and wings, if not hearts, fluttering wildly, seek the presence of those undemonstrative if not stolid damsels? It is not by the sense of sight, because it is in the darkness of the night, and the darker and more foggy the night the better. Moreover, moths cannot see through the walls of houses nor into the collecting box in the pocket of the insect hunter.

It is not by the sense of hearing as in the mosquito, for these lepidopterous damsels have not the gift of song. They are silent as the Sphinx. It is not by the sense of touch, as they wing their way from places miles distant. Unless it is by the sense of smell, a modification it is true of the sense of touch, we are unable to account for this trait of assembling. That burying beetles perceive carrion at great distances through the sense of smell is not a matter of doubt, and it is not unreasonable to suppose that undulations of odoriferous particles, moving like waves of sound and light, strike the delicate branches and hairs of the male antennæ, causing them to vibrate in unison, and thus powerfully excite the amatory nature of these ardent suitors.

So much for the feelers of insects in general and those of our Aphis (Fig. 72) in particular. Now as we are drawing

FIG. 72.

Aphis.

the legs we may notice that there are six of them attached to the sides of the middle region of the body, the "thorax." The number is invariably six in all winged insects. The thorax consists of three segments or rings, and to the side of each ring a pair of legs is attached. Now the legs are tube-like, jointed at intervals, ending in two short toe joints. In most insects there are five such joints in the toe, and ten joints in all. The last joint ends in a pair of long and slender claws.

The hind body, or "abdomen," is full and rounded, aldermanic in its proportions, and provided with two tubes, which

project out from near the end of the body. From these two tubes issues the so-called honey dew, the delight of the sweet toothed ant. When a brood of aphides are busily engaged in tapping the stems of some plant, and the honey dew is dropping upon the ground or leaves below, a procession of sable ants enliven the scene.

This sweet fluid is also designed to afford nourishment for the young as soon as hatched. Both Bonnet and the Belgian naturalist Morren observed that the young Aphides as soon as born sucked up the fluid with their beaks, and thrived upon that for a while, before attacking the juices of the plant itself.

It has been a matter of curiosity to us how this thin fluid is secreted. Morren* has demonstrated that these tubes are in reality modified respiratory organs, as Bonnet had supposed. They are simply tubular elongations of the skin with a hole at the end, into which the air enters, while the sweet fluid escapes from the same hole. On dissecting the little creature, a task requiring much time and patience, Morren found a net-work of air tubes (tracheæ) near the base of each tube. This tube, he says, is "only a prolonged stigma, and it becomes evident that it is the air of these tracheæ which forces out the fluid with which this appendage is often filled." At the base of the tube he also found a gland which secretes the sweet liquid. The latter passes into the tube or excretory canal at the same time as the air within presses out. The viscous liquid is thus thrown out during expiration. Morren tells us that he has "several times seen the young Aphides suck the end of these tubes while holding their beaks near it. This always happened whenever I was able to have the females bring forth their young in vials without any leaves to serve as food for either the young or its mother. Now a gland situated on the surface of the body, provided with an excretory canal, and secreting a sweet fluid intended to nourish the young is in fact

*Annales des Sciences Naturelles. Tome 6. Second series, 1836. Paris.

a mammary gland," and he then compares these insects in this respect to the mammals.

Now upon pressing the body of the Aphis, placed in a drop of water in the animalcule stage, we readily squeeze out the contents of the abdomen, including the ovaries. Instead of a numerous mass of eggs in various degrees of maturity, we are astonished to see a series of young Aphides, in various stages of development. The creature brings forth its young alive. Moreover, the parent, as Bonnet observed, is a virgin. No males are in existence. The first brood hatching out in the spring are all females. As soon as the leaves unfold the virgin rears its brood of young; these in turn produce their spinster offspring, and the number of broods is only limited by the approach of frost. Finally, after from eight to ten broods, males and females appear; the latter lay fertilized eggs, by which the species is represented during the winter. Such are the powers of multiplication of these Aphides that a spring-born virgin may become the happy mother of a quintillion daughters and granddaughters. At least such is the belief of M. Fougard as quoted by Prof. Morren in his well known paper "Sur le Puceron du Pêcher." A certain species which Fougard calls "Puceron lanigère" produces ten viviparous generations and one oviparous generation. Each generation produces from ninety to one hundred and fifteen individuals, the mean of which is one hundred. He thus obtains the following table of generations: —

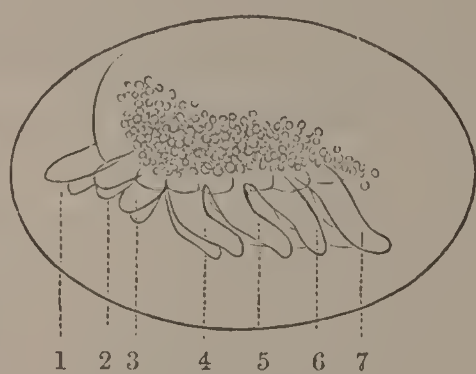
Generation.	Produce	
1st	1,	Aphis,
2d	100,	one hundred.
3d	10.000,	ten thousand.
4th	1,000,000,	one million.
5th	100,000,000,	hundred millions.
6th	10,000,000.000,	ten billions.
7th	1,000,000,000,000,	one trillion.
8th	100,000,000,000.000,	hundred trillions.
9th	10.000,000,000,000,000,	ten quadrillions.
10th	1,000,000,000,000,000,000,	one quintillion.

Regarding this estimate of what one Aphis can do to populate the world, Prof. Huxley makes the following statement: "I will assume that an Aphis weighs one-thousandth of a grain, which is under the mark; a quintillion will on this estimate weigh a quadrillion of grains. He is a very stout man who weighs two million grains; consequently the tenth brood alone, if all its members survive the perils to which they are exposed, contains more substance than five hundred million stout men, to say the least more than the whole population of China." That the individual with the potential ability to produce such a mass of young only succeeds in leaving perhaps two eggs to represent its species at the beginning of winter, all its offspring dying off, is a significant fact, illustrating forcibly the terrible struggle for existence going on in the animal world.

I scarcely know how to present in a popular way the mode of growth of the embryo Aphis. It has been well described by Huxley, and in a more exhaustive manner by the Russian naturalist Metznikoff. This study of the earliest phases in the life of an insect, or in fact any animal, leads us up to the very threshold of the mysterious portals of life. The problem given is, a sac full of protoplasm, a drop of jelly like the jelly in the cell of a plant, to our eyes the same, so far as our finite analysis at present extends, and yet potentially an animal, even representing the initial point of man himself. How is this result attained? This drop of oily jelly contains another sac filled with albumen, called the nucleus. Now when that mysterious act, the mingling of the contents of a sperm cell with the ovarian cell, or as in the virgin Aphis, the act of budding—the simplest generative process known—has occurred, let us with the practised eye of our Russian guide watch the behavior of the two elements, the general oily contents of the egg, or yolk, and the albuminous nucleus. The original protoplasmic mass has, prior to the union with a sperm cell, increased in size and

become filled with yolk cells or granules. After fertilization the nucleus subdivides into smaller cells. These seek the outer region of the egg. They multiply a thousand fold, become pressed together, lose their character as distinctive cells and form a pale band partly or wholly surrounding the yolk mass. This is the primitive band, the germ, which grows at the expense of the yolk cells. Finally feet and jaws and antennæ bud out from the band, until the form of an Aphis is rudely sketched out. Mark the fact, one of the most interesting in the morphology of animals, that at first the only difference between the antennæ and jaws and the legs are in their position. Identical in form, the antennæ and jaws differ from the limbs simply in the fact that they are situated in front of the legs. Now as each pair of appendages, whether legs or jaws or antennæ, indicate a segment or ring, we at once get a clew by which we can easily settle the question of the number of segments in the head of the winged insects. Here, following one another in orderly succession, are four pairs of protrusions like the fingers of a glove, beginning with the antennæ, the foremost, and ending with the labium, the pair next the legs. So we have four segments in the head. In after life the segments, clearly to be seen in the embryo, become so coalesced that it is impossible to define their limits. In most books the head is quite wrongly counted as one segment.

FIG. 73.



Embryo of Dragon Fly.*

An important point clearly demonstrated by Metznikoff is one bearing on the question of the origin of sex. It is maintained by some that well-fed caterpillars, for example, produce female butterflies, while starved ones produce males.

*1, antennæ; 2, mandibles; 3, first pair of maxillæ; 4, second pair; 5-7, legs.

But it is generally and correctly thought that sex is determined at the time of conception. Now in the Aphis embryo, at a stage long before even the rudiments of feet appear, Metznikoff figures certain cells which are destined to form eggs, and soon after the germ has acquired limbs a mass of these eggs may be plainly seen. So the egg is to our eyes feminine almost as soon as it begins to grow.

It is interesting to watch the finishing strokes Nature puts to her master pieces. Shortly before hatching, the embryo, so far as regards the mouth-parts, resembles that of a fly or beetle or bee nearly as much as a bug; and it is to be remembered that the beak of the Aphis is really a very complex affair. It is composed of jaws (mandibles) and the front pair of maxillæ, which form two pairs of bristle-like organs ensheathed within the labium or under lip (second maxillæ). Metznikoff's figures show us how this wonderful transformation of parts takes place. How the mandibles and first maxillæ suffer an arrest of development, while the second pair of maxillæ are greatly enlarged and joined together to form the so-called labium or under lip, until finally the parts assume the beak-like form of the mature insect.

Thus from the simplest of beginnings the most complex results follow. "Give me a point on which to rest my lever," said Archimedes, "and I will lift the world." "Give me a drop of protoplasm," says the biologist, "and I will construct the world of animals and plants." Let us remember that all animals, as well as plants (except one-celled ones), result from the subdivision of a single primitive cell, and that, simple as this process is, yet mystery upon mystery accompanies each process. What is the power that urges on the self division of cells, that arranges them into forms so varied as the world presents? Is life a function of protoplasm? What is the difference between these sacs of protoplasm, that one becomes a plant, another a monad, another a fish, and another, to speak in the concrete, a Shakspeare

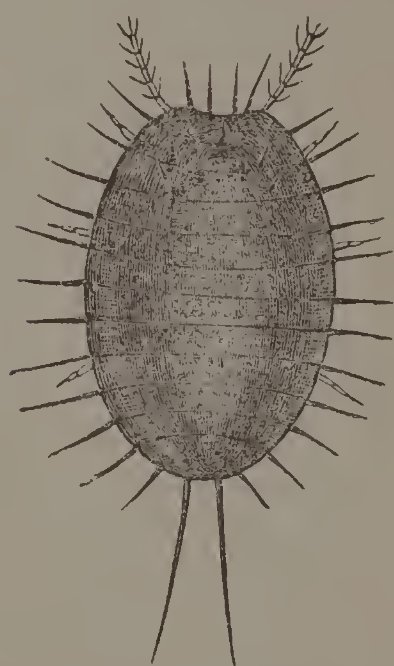
or a Humboldt? Simple as the process appears to our eyes, the determining cause is still an unfathomed mystery. The humble truth-seeking observer can only ponder and work on, hoping that the solution may be possible to his race. Certainly all is not known, when with some naturalists and philosophers we attempt to settle the question by saying that life is a function of protoplasm; though it is granted that life on this globe does not exist without it. For protoplasm is potentially a very variable substance, and life a problem quite beyond the science of our day to settle, whatever may be the flood of light thrown upon the question by modern science. The life force existing in protoplasm is powerless without an Infinite intelligence and will urging it on in its destined channels, just as muscular force is subject to the finite will that calls it forth. Though muscular force is a function of muscle, that does not account for a muscular act, nor does the nerve cell or fibre account for a nervous act; both are impelled by a will force not of themselves, as Matthew Arnold would say. So at the outset all life may have been the result of chemico-physical forces, producing from its elements, and acting upon the compound thus produced, which we call protoplasm. Still this act of "spontaneous" generation was none the less under the guidance of an all-pervading intelligence and will. Spontaneous generation is not self-creation.

So the study of our little Aphides ends in starting a series of questions that haunt us each step we take, some of them the largest that baffle the human reason. Certainly the mind of the naturalist need not grow rusty. Problems of matter and life and spirit assail him on every side, and the calmness, patience and breadth of conception their consideration involves are a fitting preparation for encountering the problems of his own existence.

Our studies over, now arises a practical question. How shall we exterminate these troublesome pests? In dealing with these insects in the hot house, where there are no insect

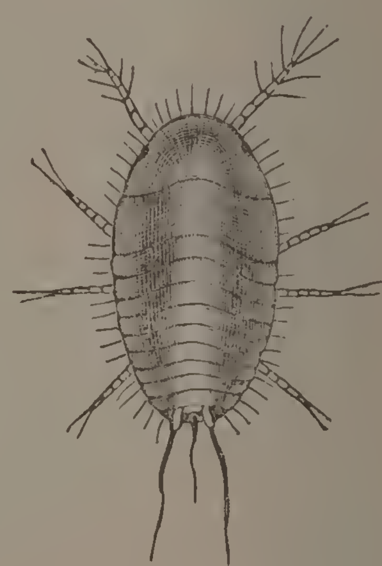
enemies, we are left solely to our own resources, so feeble compared with nature's. The best remedy against plant lice is to fumigate the plant house with tobacco. Shirley Hibbard says that the "best fumigator is one with a revolving fan, or a revolving cage containing the tobacco, by means of which the smoke is blown out in a rapid, dense, killing cloud; but an effectual instrument may be extemporized by knocking a hole in the side of a large flower pot, and then having put some hot cinders and damp tobacco in it, the nozzle of a bellows is placed against the hole, and ejection promoted by gentle puffing." Drenching the leaves with a syringe or

FIG. 74.



Mealy bug, female.

FIG. 75.



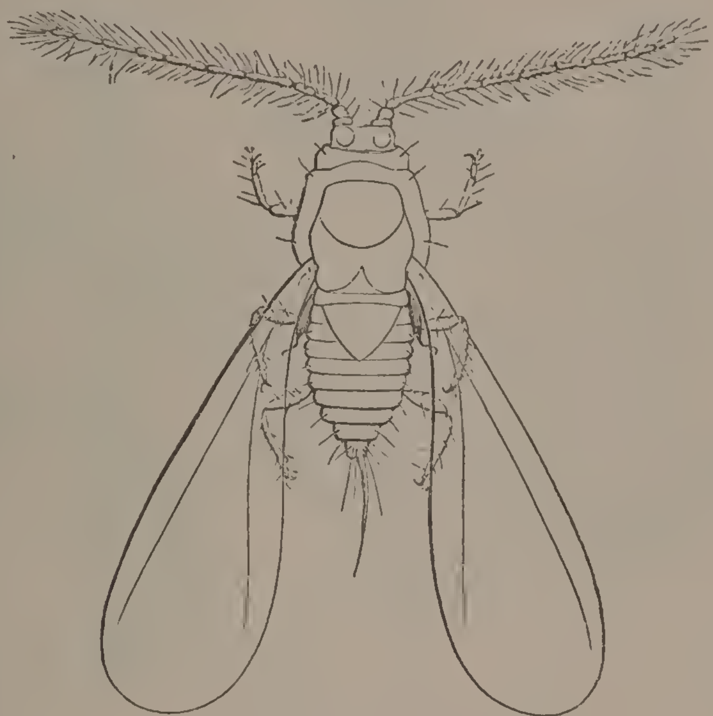
Scale insect (young).

hose, throwing hot water (150° F.) on them, is the best remedy against all plant house pests. After the drenching, sprinkle powdered tobacco over the leaves.

Scale Insects.—If we take an imaginary wingless Aphis, flatten the body, shorten and weaken the limbs, elongate the beak into threads, and endow it with a still more sluggish disposition, we shall have a scale insect in its simplest form, the "Mealy bug" of our conservatories (Fig. 74, enlarged). It may be seen on comparison with the immature or larval

form of the true scale insects (Fig. 75, enlarged) that the female Mealy bug is but little more advanced in organization than these larvæ, though greatly exceeding them in size. The male mealy bug (*Coccus adonidum* Linn.) is like the male scale insect (Fig. 76, enlarged), and still more nearly resembles that of the cochineal, which is two-winged, with two long caudal waxy threads. While the female Coccus undergoes no transformations, the male does, spinning a cocoon. Here we have a wonderful difference in form and

FIG. 76.



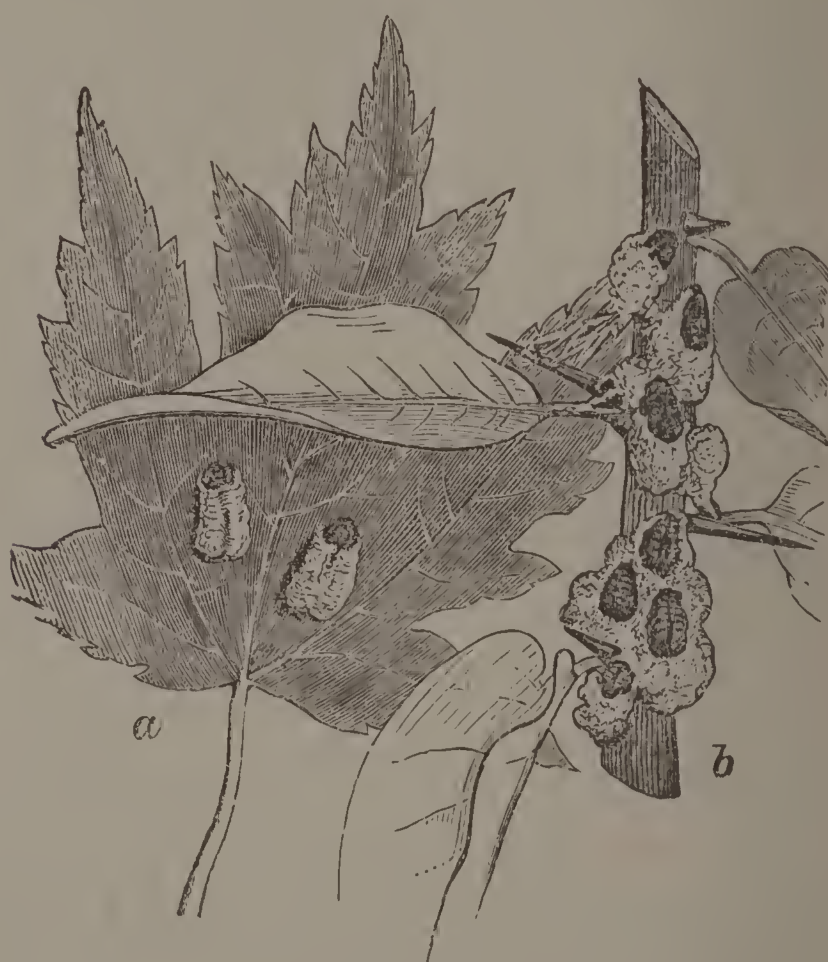
Pine Scale Insect, male.

habits between the sexes, the female attaining the adult state by simple increase in size of the larval form, while the male passes through a well marked metamorphosis. This shows conclusively that metamorphosis is an acquired mode of growth. The Coccus is a tenth of an inch long, covered with a white, cottony, mealy substance. The young are rather narrower than the old ones. The latter when about to lay its eggs, adheres by the long, slender beak to the surface of the leaf, and secretes from the abdomen a large cottony mass of fine particles of wax, which surrounds and partially

covers the end of the body, enveloping the pale orange oval eggs.

It is especially injurious to the camellia, hiding about the buds, to the azalea, oranges, lemons and similar plants. Washing the plants with strong soap suds is a good remedy. Prof. S. G. Maynard, in charge of the fine plant house of the Massachusetts Agricultural College, recommends washing

FIG. 77.



Woolly Scale Insect.

the plants with ninety-five per cent. alcohol, applying it with a small bristle brush. Few plants are injured by alcohol; they are the Pandanus, the paper Aralia and certain ferns.

A step higher in the family of scale insects (Coccidæ) and we come to the Lecanium bark-louse, of which the adjoining figure by Mr. Riley gives an admirable idea (Fig. 77 *a*, *Lecanium acericola; b, L. Macluræ*, which lives on the Osage

Orange). The dark part is the insect, the pale portion the cottony or woolly down enveloping the eggs and young larvæ. The female is flat and scale-like, while the male is two-winged. All these scale insects are closely allied to the wax producing Coccus.

Professor Silliman informs us, in the "American Naturalist," that it may be "interesting to non-chemical readers to know that this insect wax is a definite compound somewhat resembling spermaceti in appearance, but not in composition, being a cerotic ethèr known as cerotate of ceryl, of the formula $C^{59} H^{108} O^2$. It is crystalline, and of a dazzling whiteness like spermaceti, but more brittle and of a more fibrous texture. It does not completely saponify by boiling in potash water, but is completely decomposed when melted with potash, yielding cerotate of potassium and hydrate of ceryl. It is consumed in China for candles and also as a medicine. It melts at about 118° F." Prof. Silliman quotes from a recent book by C. C. Cooper (Travels of a Pioneer of Commerce in Pig Tail and Petticoats, etc., London, 1871) the following interesting account of the cultivation of this wax insect. "On the third day we entered the white wax country, so named from its producing the famous white wax of Szchuan, which has been erroneously called vegetable wax. This district was less undulating than that of the tea gardens, and presented to the eye a view of extensive plains surrounded by low hills. The plains were all under wax and rice cultivation, the wax trees being planted round the embankments of the small paddy fields, which were at most thirty yards square. The country thus presented to the passing traveller the appearance of extensive groves of tree stumps, each as thick as a man's thigh and all uniformly cut down to a height of about eight feet, without a single branch. The cultivation of wax is a source of great wealth to the province of Szchuan, and ranks in importance second only to that of silk. Its production is not attended with much

labor or risk to the cultivator. The eggs of the insect which produces the wax are annually imported from the districts of Hochin or Hoking and Why-li-tzou in Yunnan (where the culture of the eggs forms a special occupation) by merchants who deal in nothing else but pa-la-tan, 'white wax eggs.' The egg clusters which were described to me as about the size of a pea are transported carefully packed in baskets of the leaves of the pa-la-shu, 'white wax tree,' which resembles a privet-shrub, and arrive in Szchuan in March, where they are purchased at about twenty taels per basket. The trees by the middle of March have thrown out a number of long tender shoots and leaves, and then the clusters of eggs enclosed in balls of the young leaves are suspended to the shoots by strings. About the end of the month the larvæ make their appearance, feed on the branches and leaves, and soon attain the size of a small caterpillar or rather a wingless house fly apparently covered with white down, with a delicate plume-like appendage, curving from the tail over the back. So numerous are they that, as seen by me in Yunnan, the branches of the trees are whitened by them, and appear as if covered with feathery snow. The grub proceeds in July to take the chrysalis form, burying itself in a white wax secretion, just as a silkworm wraps itself in its cocoon of silk. All the branches of the trees are thus completely coated with wax an inch thick, and in the beginning of August are lopped off close to the trunk and cut into small lengths which are tied up in bundles and carried to the boiling houses, where they are transferred without further preparation to large caldrons of water, and boiled until every particle of the waxy substance rises to the surface. The wax is skimmed off and run into moulds in which shape it is exported to all parts of the empire.

It would seem that the wax growers find that it does not pay them to reserve any of the insects for their reproductive state, and hence the necessity of importing the eggs from

Yunnan. In the district of Hochin and Why-li-tzou, where the culture of the eggs is alone attended to, both frost and snow are experienced, so that it would not be difficult to rear the insect in Europe, and considering its prolific nature, the production of white wax might repay the trouble of acclimatizing this curious insect."

A near relation of the wax is the cochineal insect which affords us such an invaluable dye (carmine). This insect (Fig. 78, showing the wingless female, natural size and enlarged, and the two-winged male) is now abundant on the prickly pear in one corner of our Union (Key West) where we have found both sexes in great abundance. The "grain" is the female Coccus dried. So much has been written about this useful insect, of its mode of life and the methods of collecting and preparing it that we will not weary our readers with a repetition of it. Its value, however, in commerce is very great. In 1855, before red garments became fashionable, says Dr. Lankester in his "Uses of Animals," Great Britain imported 1400 tons of cochineal (it takes 70,000 of these insects to make a pound) which was valued at about £700,000, and since then their consumption has probably greatly increased. "Carmine," he adds, "is one of the most powerful of coloring matters; one grain of it, it is said, will dye a single silk fibre upwards of three thousand yards in length."

FIG. 78.

Cochineal Insect.

Other kinds of Coccus produce a carmine dye, and our own species, were the individuals sufficiently abundant, could be used for this purpose. Before cochineal was introduced into Europe, the bodies of another kind of Coccus, known as "grains of Kermes," were used in Europe, especially about the shores of the Mediterranean. Lankester says that "it is found extensively in Algeria, and the red Fez caps, which

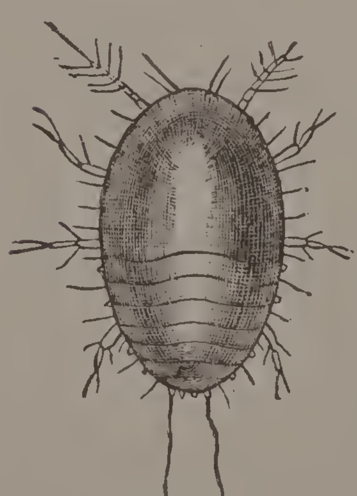
find their way into the European markets, are dyed with Kermes. Carmine is also made from it." Manna is said to be produced by the stings of the *Coccus manniparus* first described by Ehrenberg, who found it at Sinai growing on the tamarix. The lac insect, so valuable a commercial product, is a bark louse which lives in the East Indies on the *Ficus religiosa.* This insect, by its beak, punctures the bark especially of the branches. From this puncture exudes "a quantity of vegetable matter which eventually surrounds the lac insect and her eggs and larvæ, and produces on the branch an irregular brown mass, which encircles it and which when broken has a resinous aspect. This is gum lac." (Lankester). When found on the twigs it is called stick lac, but after it has been pounded, and the greater part of the coloring matter extracted by water, it is called seed lac; when melted down into cakes after it has been strained and formed into thin scales, lump lac and shell lac.

The most troublesome scale insect found on cultivated plants is the white scale insect or *Aspidiotus bromeliæ* (Fig. 79). The snow-white round scales crowd one another on the leaves of acacias, the Olea fragrans, Guidia simplex, etc. On examination with the microscope the dead and shrivelled body of the female may be seen in the centre. It is oval in form, with a ridge along the middle, and yellowish, contrasting with the snow-white thin edge of the scale, the surface of which is minutely granulated and white, as if frosted.

FIG. 79.

Aspidiotus bromeliæ.

FIG. 80.



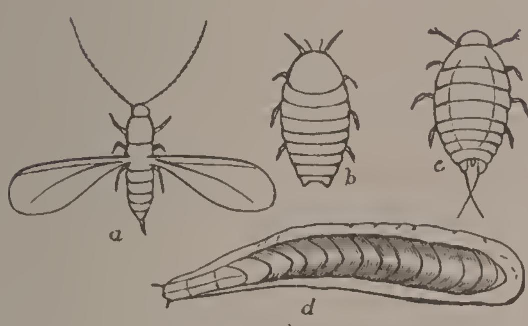
Young of A. bromeliæ.

The young (Fig. 80, enlarged) are thick and convex, with the hind edge simple. The segments (not all indicated in the cut) are quite indistinct. Around the edge of the posterior third of

the body is a series of minute tubercles, alternating with the fine hairs fringing the edge.

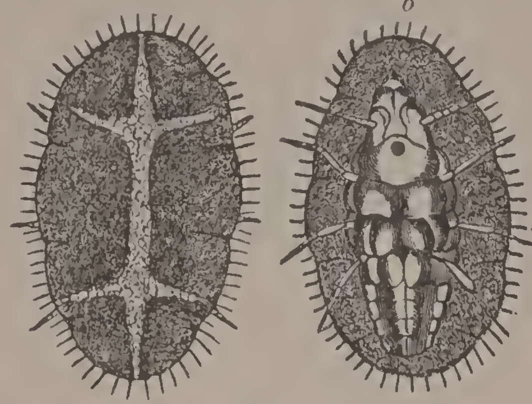
Another destructive scale insect is represented by figure 81 (*a*, male ; *b*, female ; *d*, scale ; *c*, female of another species

FIG. 81.



Orange Scale Insect.

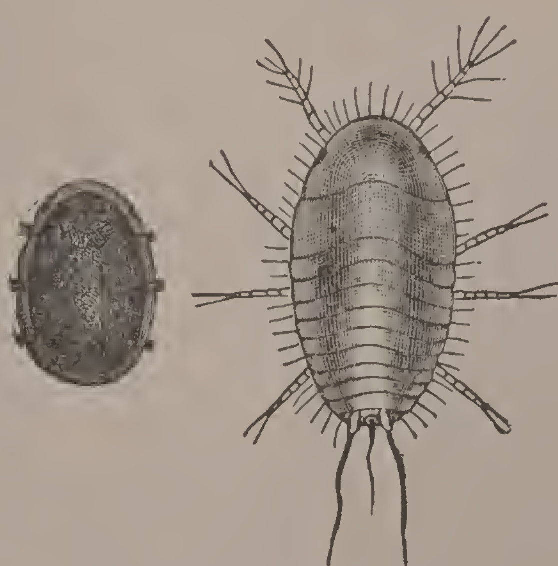
FIG. 82.



Fern Scale Insect.

also found on the orange). It is the orange bark louse, and infests both the orange and lemon. It is so abundant at times that all the branches of the plant have to be cut back to the trunk. It closely resembles the apple scale insect, and is called *Aspidiotus Gloverii*. It is possibly the *A. aurantii* or *citri* of southern Europe.

FIG. 83.



Lecanium platycerii and larva.

The fern bark louse, or scale insect (Fig. 82 ; *b*, underside ; enlarged), found frequently on ferns of the genus Pteris, seems to be identical with the Lecanium of the ferns, *L. filicum* of European authors. It is regularly oval elliptical. Along the middle of the body runs a prominent ridge, considerably thickened in the middle, with two transverse ridges. It is of a rosy tint, pale around the edge of the body, and with a darker patch in the angles between the median and transverse ridges ; beneath flesh-colored.

Another Lecanium found on the leaves of Platycerium alcicorne is *L. platycerii*. The scale is regularly oval, flattened, slightly convex above, with a slight ridge along the middle of the body. In dry specimens, especially the smaller ones, there are minute ridges radiating from the middle to the outer edge. The body of an adult female (Fig. 83, and larva, enlarged) is entirely flat beneath, finely granulated, and pale brown above. The young are thin and flat, scale-like, and of a light reddish brown color.

The Plant House Aleurodes.—Belonging to a group allied to the scale insects is a minute white-winged insect which may be found in all its stages on fuschias, the Salvia splendens, and out of doors in summer, the tomato, rising in clouds like snow flakes, when disturbed. These pretty, active beings (Fig. 84, enlarged) have pale, yellow bodies and pure white, unspotted, powdery wings, with dark red eyes; the beak is very long and dusky at tip, and reaches beyond the base of the thorax. In this genus both sexes are winged. The young of this species, the *Aleurodes vaporarium* of European authors, is broad, oval, thick, with a longitudinal ridge; the abdomen is wrinkled transversely, the head and thoracic segments being smooth. It is three-hundredths of an inch in length.

FIG. 84.

Aleurodes.

FIG. 85.

Pupa of Aleurodes.

The pupa (Fig. 85) is convex, rather thick, oval, elliptical, with a fringe of hair-like filaments around the edge of the body, from the top of which arise from six to nine long threads.

The Hot-house Thrips (Fig. 86, magnified).—This is one of the greatest pests in our hot-houses. It is the *Heliothrips hæmorrhoidalis* of Burmeister. In all its stages it may be found puncturing the leaves of liliaceous plants, azalias,

Pellea hastata, aspidium, pinks, etc., and by its attacks causing the surface of the leaf to turn red or white in blotches, or sometimes the whole leaf withers and whitens. The larva and pupa are white, long, with short antennæ. After several successive changes, it assumes the adult state, and the pupa may be found in different stages of growth, with the antennæ turned underneath the head, and the rudimentary wings folded to the sides of the body. The eyes are pink. The half-grown young are shorter and broader than those fully mature. The adult is black, with the extremity of the abdomen bright rust red. The antennæ and legs are white, the base and sixth joint of the former dusky, while the wings are almost hyaline. The body above is entirely covered with a net-work of elevated lines, forming pretty regular hexagons, equal in size on the head, where they are largest, to those of the eyes, and disposed in perfect rows on the abdomen. It is about one-twelfth of an inch in length.

FIG. 86.

Thrips.

The best remedy against them is repeated washings with soap-suds, cleaning each leaf by itself, or turning the hose upon the plants.

The Red Mite.— Usually called "red spider." This little mite (*Tetranychus telarius* Linn.) is a universal pest in hot houses, and in dry seasons abounds on the peas, etc., in gardens. Its eggs and young may be found on the rose and other plants of the conservatory all the year round. Its presence may be detected by the blotched and withered appearance of the leaves, and the small web. Frequent showerings will reduce its numbers. Sulphur dusted frequently over the leaves is an excellent remedy.

5. Edible Insects.

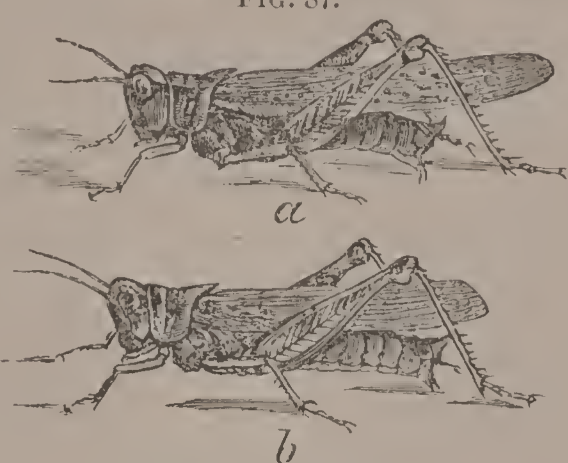
THE crustacea afford in the northern lobster, the spiny lobster of the tropics, and numerous kinds of shrimps and crabs, many choice bits for our larder. Whether, however, any of the insects, or their allies the spiders, or even the worms, will ever afford food to civilized man is a matter of grave doubt. While the bulk of our animal food is given us by the vertebrated animals, the ox, sheep, fowl and game being our main dependence, the mollusks afford us the delicious oyster which we shall never be able to give up, the less aristocratic clam, handed over to the Pilgrim Fathers by the sagamores and their followers, the delicious though rare scallop and the quahaug, while mussels, snails and whelks regale our transatlantic friends. Honey is universally sought, and that is an insect product, but the flesh of insects is, upon the whole, repugnant to our feelings. This is certainly unreasonable, for multitudes of the locust or grasshopper of the East are eaten by Arabs and the savages in other parts of Africa. We look with repugnance upon a roasted grasshopper, but an Arab is said to have expressed his abhorrence at our eating raw oysters. While in their sudden flights the grasshoppers cover the ground and eat up every green thing, the natives adopt the sensible course of devouring them in turn. The Bushman, who is no farmer, sings

> "Yea, even the wasting locust-swarm,
> Which mighty nations dread,
> To me nor terror brings nor harm;
> I make of them my bread."

He collects them, according to Andersson, by lighting large fires directly in the path of their swarms. As the insects pass over the flames, their wings are scorched and they fall

helplessly to the ground. They are also, he says, collected by cartloads when they have retired to rest. "The locusts, after being partially roasted, are eaten fresh, or they are dried in the hot ashes, and then stored away for future emergencies. The natives reduce them also to powder, or meal, by means of two stones or a wooden mortar, which powder, when mixed with water, produces a kind of soup or stir-about. I have tasted locusts prepared in various ways, but I cannot say that I have found them very palatable. But they must contain a vast deal of nourishment, since the poor people thrive wonderfully on them." He also states that "the Cape Colony has been particularly subject to this dreadful scourge, which is invariably followed by famine. The inroads of the locusts are periodical; according to Pringle, about once every fifteen years. In 1808, after having laid waste a considerable portion of the country, they disappeared and did not return until 1824. They then remained for several years but in 1830 took their departure." The locust is truly migratory, the undeveloped, partially winged young moving from one region to another. He quotes from Barrow, who says that "the larvæ at the same time were emigrating to the northward. The column of these imperfect insects passed the houses of two of our party, who assured me that it continued moving forward without any interruption, except by night, for more than a month."

FIG. 87.



Destructive Grasshoppers.

Of very similar habits is our red-legged grasshopper (*Caloptenus femur-rubrum*, Fig. 87, *b*). It appears at intervals in immense swarms. In 1871 it was very destructive to grass in northern Maine, seriously damaging the hay crop.

It has also swarmed in Canada. Dr. Harris enumerates its visitations in New England in the last century when it devoured every green thing. The habits of this species are not well known, except that it appears in midsummer in the winged state. The wingless larvæ appear in June, and, as Harris recommends, hay crops should be mown early, before the insects fly in swarms. The last of summer they couple and lay their eggs in holes in the earth, where they are hatched in the spring.

As Harris suggests, this insect can only be kept under by concerted action on the part of farmers. "In the south of France the people make a business, at certain seasons of the year (probably in the autumn and late in the spring), of collecting locusts and their eggs, the latter being turned out of the ground in little masses, cemented and covered with a sort of gum in which they are enveloped by the insects." Various forms of drag-nets can be invented for collecting them in large numbers, and run, if necessary, through a field by horse-power. The inventive genius of our farmers will easily suggest methods of gathering these insects by the bushel, when they can be thrown into hot water, and fed to swine. An entomological friend has found by his own experience that roasted grasshoppers are excellent eating — "better than frogs." Only let some enterprising genius of the kitchen once set the example of offering to his customers roasted grasshoppers, rare-done, and fricasseed canker worms (for we have it on the word of an entomologist that caterpillars are pleasing to the palate of man), and these droves of entomological beeves will perchance supplant their vertebrate rivals at the shambles, and instead of cattle fairs, we shall have grasshopper festivals, and county caterpillar shows.

The *Caloptenus spretus* of Uhler (Fig. 87 *a*) appears in immense numbers in the country between the Mississippi and the Rocky Mountains, and extending from the Saskatch-

ewan river on the North to Texas. Mr. Scudder states that "a third, whether belonging to the same species or not is still uncertain, has invaded, at different times, nearly all the country lying within the boundaries of the United States between the Rocky Mountains and the Pacific Ocean."

Dr. Lincecum thus describes the ravages of *C. spretus* in Texas: "Last spring the young were hatched from the egg in the early days of March; by the middle of the month they had destroyed half the vegetation, although the insects were wingless and not larger than a house-fly. The first winged specimens were seen high in the air at about three in the afternoon; as a light northerly breeze sprang up, millions dropped to the earth, covering the ground in an hour, and destroying every green thing with avidity. During the night they were quiet, but at daybreak commenced to eat, and continued until ten in the morning, when they all flew southward. At about three o'clock in the afternoon of the same day another swarm arrived, ten times as numerous as the first; these again took flight the following day; and thus they continued, coming and going, day after day, devouring the foliage and depositing their eggs. At first they selected bare spots for this purpose, but finally the whole surface of the earth was so broken up by their borings that every inch of ground contained several patches of eggs. This visitation was spread over many hundreds of miles."

Of other insects eaten by man we may instance the humble bee whose body is often sacrificed to the love of boys for sweets, who since Shakspeare's time have searched for the "well bestratted bee's sweet bag;" while in Ceylon bees are eaten bodily as food. Some kinds of ants are eaten by the Indians of the Gulf coast of Mexico. Sumichrast says (see our "Guide to the Study of Insects," p. 187) that "the natives eat the females after having detached the thorax;" and Humboldt tells us that ants are eaten by the Indians of South America. Kirby speaks from his own

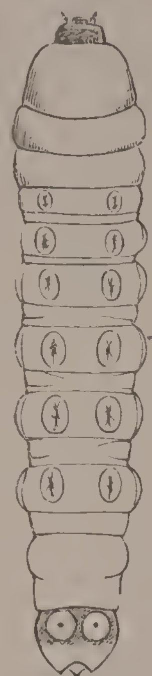
experience: he says "that ants have no unpleasant flavor; they are very agreeably acid, and the taste of the trunk and abdomen is different." He refers to the fact that "in some parts of Sweden ants are distilled along with rye to give a flavor to the inferior kinds of brandy." Certain galls are esteemed in Constantinople for their aromatic and acid taste, and Réaumur says that the galls of the ground ivy have been eaten in France, but he thinks it doubtful if they ever rank with good fruits (Kirby).

Réaumur has suggested that the numbers of injurious caterpillars might be judiciously lessened by our using them as food. Kirby and Spence in their admirable "Introduction to Entomology" give a list of the lepidopterous larvæ eaten by man.

"Amongst the delicacies of a Boshies-man's table, Sparrman reckons those caterpillars from which butterflies proceed. The Chinese, who waste nothing, after they have unwound the silk from the cocoons of the silkworm, send the chrysalis to table: they also eat the larva of a hawk-moth (Sphinx) some of which tribe, Dr. Darwin tells us, are, in his opinion, very delicious; and lastly, the natives of New Holland eat the caterpillars of a species of moth of a singular new genus, to which my friend, Alexander MacLeay, Esq., has assigned characters, and from the circumstance of its larva coming out only in the night to feed, has called it Nycterobius. A species of butterfly also (*Eublœa hamata* MacLeay), as we learn from Mr. Bennett, congregates on the insulated granitic rocks in a particular district which he visited in the months of November, December and January, in such countless myriads (with what object is unknown), that the native blacks, who call them Bugong, assemble from far and near to collect them, and, after removing the wings and down by stirring them on the ground previously heated by a large fire, and winnowing them, eat the bodies, or store them up for use by pounding and

smoking them. The bodies of these butterflies abound in an oil with the taste of nuts; and when first eaten produce violent vomitings, and other debilitating effects; but these go off after a few days and the natives then thrive and fatten exceedingly on this diet, for which they have to contend with a black crow, which is also attracted by the Bugongs in great numbers, and which they despatch with their clubs, and use as food" (Kirby).

FIG. 88.



Prionus.

Among beetles the grubs of the gigantic palm weevil are roasted and eaten by natives in the tropics, and the larva of the large Prionus (much like the one here figured, Fig. 88) is "eaten at Surinam, in America, and in the West Indies, both by whites and blacks, who empty, wash and roast them, and find them delicious. Mr. Hall informs me, that in Jamaica this grub is called *Macauco*, and is in request at the principal tables. A similar insect is dressed at Mauritius under the name of *Moutac*, which the whites as well as negroes eat greedily," and Mr. Kirby, from whom I have quoted, thinks, with Dr. Darwin, that the grub of the common cockchafer might be added to our *entremets*. Who will set the example on this side of the Atlantic of eating the common white grub, or young of the May beetle (Fig. 89), so destructive to our strawberry beds?

FIG. 89.

May Beetle, grub.

The Cicada or harvest fly, to which Anacreon inscribes an ode, was eaten by the Greeks. Aristotle says that the pupæ are most delicious, and after they change to the winged state the males at first have the best flavor, while the females are better on account of the eggs. "Athenæus also and Aristophanes

mention their being eaten; and Ælian is extremely angry with the men of his age, that an animal sacred to the muses should be strung, sold and eagerly devoured." Kirby, from whom we quote, cites Peter Collinson as saying that the winged form of the seventeen year Cicada was in his time (1763) eaten by the Indians of North America. Lastly, the gravid, enormously distended female of the white ant is regarded as a delicious morsel by the Hottentots, and Smeathman "thought them delicate, nourishing and wholesome, being sweeter than the grub of the weevil of the palms."

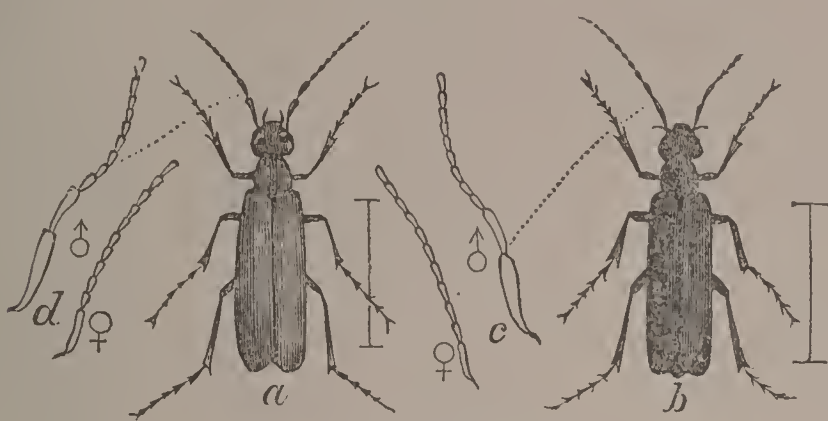
Roasted spiders are eaten by the natives of New Caledonia. Kirby says that "even individuals amongst the more polished natives of Europe are recorded as having a similar taste, so that if you could rise above vulgar prejudices, you would in all probability find them a most delicious morsel. If you require precedents, Réaumur tells us of a young lady who, when she walked in her grounds, never saw a spider that she did not take and crack upon the spot. Another female, the celebrated Anna Maria Scherman, used to eat them like nuts, which she affirmed they much resembled in taste, excusing her propensity by saying that she was born under the sign *Scorpio*. If you wish for the authority of the learned, Lalande, the celebrated French astronomer, was, as Latreille witnesses, equally fond of these delicacies." Even the centipedes are not neglected, as Humboldt records the fact that "he has seen the Indian children drag out of the earth centipedes eighteen inches long and more than half an inch broad, and devour them."

Even the eggs of certain insects are eaten. In Mexico the eggs of the Corixa, or water boatman, are often used as food, and in the same country the Indians prepare a liquor from the Cicindela (of which we figure a species) "by macerating it in water or spirit, which they apparently use as a stimulating beverage."

Druggists are indebted to insects for the Spanish fly, or blistering beetle (Cantharis) for an important article in the pharmacopœia. Our native species of Cantharis (Fig. 90, *a*, *Lytta cinerea; b*, *L. murina*), of which four are common all over the country, when dry and powdered, afford a good vesicant.

Were we living in the middle ages, or even as far back as the eighteenth century our *materia medica* would be swelled

FIG. 90.



Lytta, or blistering beetle.

by a long list of entomological nostrums, of which Kirby and Spence afford us an amusing list.

As we are indebted to the ant for lessons of prudence and thrift, so has this humble creature given one of the greatest boons to poor suffering humanity. To the ant we are indebted for the discovery of chloroform. How the discovery of this prince of anodynes came about Dr. Lankester tells us in his little work on the "Uses of Animals," p. 243.

"Some years ago, whilst editing the correspondence of John Ray, I was amused by the letters which passed between this great naturalist and Dr. Martin Lister of York, on the subject of the 'acid liquid of pismires.' It had been observed, that when ants were bruised their juices afforded an acid secretion, which substance was afterwards known as formic acid. The attention of modern chemists being thus called to formic acid, Dumas discovered that it contained a base, a compound radical, which he called formyle. This

base, with three atoms of oxygen, forms the formic acid. Now Dumas not only made this out, but he further discovered that the three atoms of oxygen might be replaced with three atoms of chlorine. He thus obtained terchloride of formyle. It so happened that, when ether had been employed as an anæsthetic, Dr. Simpson of Edinburgh was induced to look for some agent that might act even more beneficially than ether in this respect. He tried the terchloride of formyle, and found it to succeed; and this is the agent which under the name of chloroform, has been the means of alleviating a vast amount of human misery: and if occasionally it has destroyed life it has saved so much that mankind owes a deep debt of gratitude to those who have successfully introduced it into practice."

Such, then, are some of the relations in which insects stand to us. They feed us, clothe us, and lull us to sleep. The gorgeous hues and lines of grace of some fill our minds with visions of beauty; others, master pieces of ugliness, turn us to loathing. They are our companions by day, and, alas also by night. Finally, a thorough comprehension of their origin, structure and habits forms a part of that grand science —biology—which great intellects have through the centuries since the time of Aristotle, gradually and with much pains built up, and the end and aim of which is to seek the answer to the question — What is life? thus bringing the mind of the inquirer into closer relations with the Source of all Life.

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